DOCUMENT RESUME

ED 269 261 SE 046 580

AUTHOR Stanic, George M. A.; Reyes, Laurie Hart
TITLE Gender and Race Differences in Mathematics: A Case Study of a Seventh-Grade Classroom.
PUB DATE Apr 86
NOTE 32p.; Paper presented at the Annual Meeting of the American Educational Research Association (70th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Case Studies; Educational Research; *Grade 7; Junior High School Students; Mathematics Achievement; *Mathematics Instruction; *Racial Differences; Secondary Education; Secondary School Mathematics; *Sex Differences; Student Attitudes; Teacher Attitudes; Teacher Behavior; *Teacher Student Relationship
IDENTIFIERS *Mathematics Education Research

ABSTRACT

A case study of a seventh-grade mathematics classroom was conducted for almost three months in 1985-86. The purpose was to investigate factors related to mathematics achievement. The 16 students consisted of 4 black females, 3 black males, 5 white females, and 4 white males; the teacher was a black male. The data came from field notes and audio recordings of 45 class sessions, systematic coding of teacher-student interactions, artifacts gathered during the classroom observations, student permanent school records, student attitude questionnaires, and interviews conducted with the teacher and with each student. Two tentative conclusions based on the data are: (1) teacher intentionality must be considered in order to understand teacher-student interactions and (2) differential student outcomes result not only from intended and unintended differential teacher treatment of students but also from equal teacher treatment of students. (Author/MNS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED269261

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Gender and Race Differences in Mathematics: A Case Study of a Seventh-Grade Classroom

George M. A. Stanic

Laurie Hart Reyes

University of Georgia

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

George M. A. Stanic

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE 046 580

Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 1986.

Abstract

A case study of a seventh grade mathematics classroom was conducted from 28 October 1985 through 17 January 1986. Parental permission to gather data was obtained for 16 of the 17 students in the class. The 16 students consisted of 4 black females, 3 black males, 5 white females, and 4 white males; the teacher was a black male. The data came from field notes and audio recordings of 45 class sessions, systematic coding of teacher-student interactions, artifacts gathered during the classroom observations, student permanent school records, student attitude questionnaires, and interviews conducted with the teacher and with each student. Two tentative conclusions based on the data are: (1) Teacher intentionality must be considered in order to understand teacher-student interactions and (2) Differential student outcomes result not only from intended and unintended differential teacher treatment of students but also from equal teacher treatment of students.

Gender and Race Differences in Mathematics:

A Case Study of a Seventh-Grade Classroom

The purpose of this study was to investigate factors related to mathematics achievement. The goal of the line of inquiry of which this study is a part is to improve the mathematics achievement of students who do not achieve up to their potential. Previous research has indicated that, in addition to the ability of the student, factors that may be important in understanding the causes of differential achievement include: teacher attitudes about student aptitude and achievement in mathematics, student attitudes toward mathematics (e.g., confidence in learning mathematics, perceived usefulness of mathematics, beliefs about the appropriateness of mathematics as an area of study, and attributions of success and failure in mathematics), mathematics achievement-related behaviors (e.g., persistence and independence), and mathematics classroom processes (e.g., teacher-student interaction and peer interaction). Research has also shown that female students, black students, and students of low socioeconomic status (SES) are overrepresented in the group of underachievers. More work is needed which clarifies the specific role of student attitudes, student achievement-related behaviors, and classroom processes in the differential achievement of these groups.

We have incorporated these factors into a model to explain differential achievement in mathematics by gender, race, and SES (Reyes & Stanic, in press). Ultimately, the data from this study will be used to verify and revise the model. For this paper, because the data collection has just been completed, we will

focus our discussion primarily upon two tentative conclusions. After summarizing the research related to the factors listed above and describing the data collection procedures, we will discuss our tentative conclusions about the roles teacher attitudes and classroom processes play in differential achievement by race and gender.

Summary of Related Research

Differential Achievement by Race, Gender, and SES

In a comprehensive review of research literature on minorities and mathematics, Matthews (1984) stated that minority students consistently score below the national average on standardized tests of mathematics achievement. Anick, Carpenter, and Smith (1981) reported analyses of the second mathematics assessment of the National Assessment of Educational Progress (NAEP II) by ethnic group for students at ages 9, 13, and 17. The mean percentage of exercises correct for black students was well below the national average at each age level. Black students were about 11 percentage points below the national average at age 9, 15 percentage points below the national average at age 13, and 17 percentage points below the national average at age 17.

It is clear, then, that the mathematics achievement scores of black students have been consistently lower than those of white students. However, results from the NAEP data indicate some changes in the relative level of mathematics achievement for black students and white students during the last 10 years. Anick et al. (1981) compared the differences between the black

average and the national average from the 1973 mathematics assessment of the National Assessment of Educational Progress (NAEP I) with the differences found in NAEP II. From NAEP I to NAEP II the discrepancy between blacks and the national average decreased slightly at all three age levels. Matthews, Carpenter, Lindquist, and Silver (1984) reported results from the third mathematics assessment (NAEP III). In 1982, once again, black students were achieving at a level well below the national average; but the differences between the performance of black students and white students had decreased even more from 1978 to 1982 than from 1973 to 1978. The changes in differential achievement were mainly the result of an increase in test scores for black students rather than a decline in scores for white students (Burton & Jones, 1982). This increase in mathematics achievement for black students was larger in schools composed of less than 60% white students than in schools which were composed of at least 60% white students (Matthews et al., 1984).

Gender differences in mathematics achievement also persist. Though Armstrong (1985) concluded that nationwide differences in mathematics course enrollment between male and female students have decreased, at the high school level male students, as a group, achieve at a higher level in mathematics than female students as a group. This differential achievement is largest for application and problem solving tasks. Extensive reviews of the research on gender-related differences in mathematics are available (e.g., Chipman, Brush, & Wilson, 1985; Eccles (Parsons), 1984; Fennema, 1984; Fennema & Peterson, 1984).

There has been no definitive study of SES as it relates to

mathematics achievement. As part of his meta-analysis, White (1982) examined the correlations between SES and scores on standardized tests of mathematics achievement from 143 studies. He found an average correlation of .25 for all the studies, while an average correlation of .73 was found for studies where school or community was the unit of analysis and an average correlation of .22 was found for studies where the student was the unit of analysis. Yando, Seitz, and Zigler (1979) computed a correlation between SES and arithmetic achievement for 304 8-year-olds using student as the unit of analysis and obtained a positive correlation of .29. Thus, SES appears to account for less than 10% of the variance in mathematics achievement when student is the unit of analysis and considerably more when the school or community is the unit of analysis. Though more work is needed to clarify the relationship between student SES level and mathematics achievement, it is clear that there are significant differences in achievement related to the race, gender, and SES level of students.

Factors Involved in Differential Achievement

Teacher attitudes about the aptitudes of students and the appropriateness of their achieving at a high level in mathematics are translated into expectations for their students. There is a large body of literature (e.g., Brophy & Good, 1974; Cooper & Good, 1983) which indicates that teacher expectations can affect student achievement. According to Brophy and Good (1974), classroom processes serve as the mechanism through which teacher expectations affect student achievement.

Student attitudes which may affect differential achievement include confidence in learning mathematics, perceived usefulness of mathematics, beliefs about the appropriateness of mathematics as an area of study, and attributions of success and failure in mathematics (Fennema & Sherman, 1978; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Reyes, 1984).

Confidence in learning mathematics has to do with how sure a student is of her or his ability to learn and perform well in mathematics. Confidence is an important factor because it has a significant, positive correlation with mathematics achievement; because it is one of the strongest attitudinal predictors of mathematics course taking; and because gender differences in confidence are usually associated with gender differences in mathematics (Reyes, 1984). According to Matthews (1984), confidence appears not to be as important in understanding race-related differences as it is in understanding gender-related differences. However, this finding needs further clarification.

Students also vary in how useful they view mathematics to be, both for their current needs and for the future. Perceived usefulness of mathematics has been identified as one of the most important variables in understanding gender-related differences in mathematics achievement (e.g., Fennema & Sherman, 1977, 1978; Meece et al., 1982; Perl, 1979). There is a significant positive correlation between perceived usefulness and mathematics achievement, and perceived usefulness is a predictor of student election of optional mathematics courses (e.g., Meece et al., 1982; Sherman & Fennema, 1977). Matthews (1984) identified perceived usefulness of mathematics as a particularly important

variable for future research on race-related differences.

Another important attitude is a person's belief about the appropriateness of mathematics as an area of study. According to Fennema (1984), the stereotyping of mathematics as a male domain may be an important factor in the differential mathematics course taking and achievement of male and female students. There may also be race and SES differences in the perception of mathematics as an appropriate domain of study. For instance, Matthews (1984) suggests that black students may perceive mathematics as a white domain.

Mathematics education research based on attribution theory deals with perceptions of the causes of student success or failure on mathematics tasks. The main purpose of this research has been to understand gender-related differences in mathematics course taking and achievement. On the average, females and males seem to differ in their patterns of attribution of success and failure. Wolleat, Pedro, Becker, and Fennema (1980) found that males attributed their success in mathematics to ability more often than females did, and females attributed their success to effort more often than did males. Females more often than males attributed their failure in mathematics to lack of ability and to the difficulty of the task. These differences, however, are not large. More data collected using school tasks in naturalistic settings are needed not just to clarify gender-related differences in attributions but also to determine the extent to which attribution theory can explain race- and SES-related differences.

Achievement-related behaviors may also help explain differential achievement in mathematics. Fennema and Peterson (1983) claimed that a student's ability to persist at a task and to work independently on a task are important factors in explaining gender-related differences in solving higher cognitive level mathematics problems. According to Grieb and Easley (1984), white male students more than female and minority students are allowed to develop independent thinking in mathematics; they believe this is a crucial factor in males showing more creativity in their mathematics performance.

Gender-related (Fennema & Peterson, 1983) and race-related (Matthews, 1984) differences in classroom processes have been substantiated. Research on teaching has documented that certain patterns of classroom interaction are related to student achievement in mathematics (e.g., Good & Grouws, 1979). Classroom processes serve as a mechanism through which teacher expectations, student attitudes, and student achievement-related behaviors can affect student achievement (Meece et al., 1982; Reyes, 1984). Furthermore, it is through classroom processes that teacher expectations, student attitudes, and student achievement-related behaviors may change.

Data Gathering Procedures

A case study of a seventh-grade mathematics class for students of above-average ability was conducted from 28 October of 1985 through 17 January of 1986. The class was part of a coeducational middle school with a student population including black students and white students from a variety of SES levels. Parental permission to gather data was obtained for 16 of the 17

students in the class. The 16 students consisted of 4 black females, 3 black males, 5 white females, and 4 white males; the teacher was a black male. The data came from field notes and audio recordings of 45 class sessions, systematic coding of teacher-student interactions, artifacts gathered during the classroom observations, student permanent school records, student attitude questionnaires, and interviews conducted with the teacher and with each student.

Forty-five class sessions were observed, each lasting 45 minutes. For most of the sessions, both of the investigators were in the classroom. The investigators were not participants in regular daily activities but on occasion interacted with class members. For most of each class session, the investigators sat among the students taking notes.

The investigators wrote field notes and made audio recordings of classroom events. The classroom was wired with two microphones, so that most verbal interaction was recorded. The audio recordings were used by the investigators in rewriting field notes and will be used during further data analysis.

For two weeks, while one of the investigators continued to take field notes, the other investigator used a systematic observation instrument to code characteristics of teacher-student interaction. Among the characteristics coded were: the student involved; the initiator of the interaction; whether the interaction was public or private; whether the student volunteered to participate, was called on without volunteering, or called out without permission from the teacher; whether the

interaction was concerned with mathematics, classroom procedures, or other non-mathematical topics; and the type of feedback the teacher gave in response to student answers or comments.

The investigators gathered artifacts during classroom observations. The artifacts included copies of student work on daily assignments and tests and examples of teaching materials. Other information about students (e.g., parent occupation, ability and achievement scores, and previous grades) was obtained from school records.

Two questionnaires were used to measure student attitudes. One of the questionnaires consisted of the Fennema-Sherman Mathematics Attitude Scales (Fennema & Sherman, 1976). The other questionnaire was a revised version of the Mathematics Attribution Scale (Fennema & Peterson, 1984).

Individual audiotaped interviews, each lasting about one-half hour, were conducted with all but one of the students in the class. The interviews took place either before school or during lunch. Both investigators participated in each interview. These interviews focused on student attitudes toward mathematics and their teacher, their level of understanding of the content covered in class, and their interpretations of classroom events.

Five audiotaped interviews with the mathematics teacher were conducted. These interviews took place during the teacher's planning period, and both investigators participated. The teacher was asked to describe classroom events and give perceptions of the mathematics attitudes and achievement of the students in the class. Other interviews with the teacher will be conducted throughout the data analysis.

Some Directions for Data Analysis

The investigators plan to conduct a number of analyses of the case study data. The purpose of any analysis of this data set is to contribute to our knowledge about the reasons for differential achievement in mathematics. However, we do not claim the results of this case study can be generalized to all teachers and students. Instead, by describing our findings and the characteristics of the teacher, students, and context of our study, we hope to provide the possibility for other researchers and teachers to make connections with their own situations.

In this section, two tentative conclusions about the roles teacher attitudes and classroom processes play in differential achievement by race and gender will be discussed. These conclusions are:

1. Teacher intentionality must be considered in order to understand teacher-student interactions.

2. Differential student outcomes result not only from intended and unintended differential teacher treatment of students but also from equal teacher treatment of students.

Although it may appear obvious that it is important to consider teacher intentionality and that differential outcomes can result from equal treatment, we believe these tentative conclusions represent significant contributions to the literature on race, gender, and mathematics. The goal of much previous research has been to describe differential treatment of students by race and gender with the idea that eliminating this differential treatment would also eliminate the gender and race

differences in mathematics achievement. Some differences in student achievement by race and gender may be the result of teachers unintentionally treating students differently. However, one cannot be certain that observed differential treatment is due to a lack of awareness on the part of the teacher; in short, teachers may intend the differential treatment we observe. Furthermore, the answer to the problem of differential achievement is not necessarily to treat all students in exactly the same way; that is, some differential treatment may be appropriate.

Teachers are taught to treat students differently. A basic tenet of teaching is that one must adjust instruction to the individual needs and characteristics of students. It is also a normal part of human discourse to interact differently with different people. Learning how to intentionally treat people differently is, then, a part of learning how to be a teacher and learning how to communicate with other human beings. If inappropriate differential treatment of students by mathematics teachers is to be eliminated, the extent to which that treatment is intended or unintended must be determined. Making teachers aware of inappropriate differential treatment of students is a necessary (but not sufficient) strategy for eliminating such treatment only if teachers are unaware and do not intend what they are doing; in those cases where teachers are aware of and do intend the differential treatment, an entirely different approach is needed. Furthermore, after determining a teacher's intentions, one might decide that the behavior is more appropriate than was originally thought. A classroom observer usually does not know the

individual students being observed as well as the teacher does, so it is difficult to make accurate judgments about the appropriateness of a teacher's treatment of students without understanding the teacher's intentions.

Differential treatment of students is inappropriate only if it leads to individual students or groups of students achieving below their potential. Teachers, therefore, are faced with a complex task: On the one hand, they must avoid inappropriate differential treatment; on the other hand, they must adjust to those individual differences of students relevant to the learning process. Because of the complexity of the teacher's task and in order for us to understand teacher-student interactions, we must consider teacher intentionality.

Differential treatment is only part of the problem. Differential student outcomes result not only from intended and unintended differential teacher treatment of students but also from equal teacher treatment of students. That is, two students may respond very differently to the same treatment by the teacher. All students do not respond to a particular teaching style in the same way.

Evidence from the Case Study

Our interviews with Arthur Martin, the teacher whose classroom we studied, and his students and our observations of classroom interaction convinced us of the importance of considering teacher intentionality and differential outcomes of equal treatment.

Teacher intentionality. One of the first things we noticed

during our observations was that Mr. Martin treated individual students and groups of students differently. For example, Tim, one of the white male students, received a great deal of positive attention from Mr. Martin. Tim was often at the center of classroom interaction. When the class went over assignments, Tim consistently was called on for answers and called out his evaluation of answers given by other students. Although the other students expressed annoyance with Tim's behavior, Mr. Martin never reprimanded Tim for interrupting other students with his evaluative comments. Mr. Martin did on occasion reprimand Tim for goofing off with Bob, the white male student with whom Tim often interacted, or for packing up too early near the end of the period; however, the reprimand was always given with a smile or a laugh. In fact, just the mention of Tim's name made Mr. Martin laugh affectionately. Near the end of our most recent interview with Mr. Martin, he even referred to the class as "Tim's class." When the class had difficulty with a mathematics problem and Mr. Martin wanted a member of the class to explain how to do the problem, he most often looked to Tim for an explanation. In many ways, Tim was a living "teacher's guide" for Mr. Martin.

Katrina, a black female student in the class, also received much positive attention from Mr. Martin, but of a different sort. Mr. Martin laughed and joked with Tim, and the topic of most of their interactions was mathematics. Mr. Martin also laughed and joked with Katrina; however, their interactions were often about non-mathematical topics. For example, Mr. Martin and Katrina talked about his work as a free-lance photographer. He often

shared anecdotes of his personal, out-of-school activities with Katrina, but he almost never did so with Tim. Katrina and Mr. Martin did interact about mathematics, but most of this was a result of Katrina asking for help, which she did more often than anyone else in the class. There were contradictions in Katrina's behavior. On the one hand, as leader and member of a group of four black female students, Katrina was both independent and assertive. On the other hand, as a learner of mathematics, she was very dependent on Mr. Martin and rarely worked on her own longer than five minutes without asking him a question about the assignment. Tim, unlike Katrina, rarely asked Mr. Martin a question about mathematics or anything else.

Henry, a black male student, not only received less attention from Mr. Martin than either Tim or Katrina; the attention he did receive was predominantly negative in tone. The smiles and laughter that characterized almost every interaction Mr. Martin had with Tim were rare in Mr. Martin's interactions with Henry. In contrast to the mathematical orientation of Tim's interactions with Mr. Martin and the at times social, at times mathematically dependent orientation of Katrina's interactions, the orientation of most of Henry's interactions with Mr. Martin was procedural. That is, Mr. Martin most often talked to Henry about completing assignments and threatened to call Henry's parents about his lack of effort.

A student who received almost no attention from the teacher was Chris, a white female. Chris rarely sought attention from Mr. Martin or asked him questions. For most of each class period,

she worked independently on mathematics assignments. Unlike Tim, who announced to the entire class that he had finished his work, Chris would quietly get out a library book and begin to read. When Chris did interact during the class period, it was usually with Wendy, the white female student who sat next to her. There were times when Wendy, who sought only a little more attention from Mr. Martin than did Chris, would go to Mr. Martin's desk to get help, return to her desk, and answer a question from Chris about the same topic. During the times when Mr. Martin walked around the room helping students with their seatwork, both Chris and Wendy, on those rare occasions when they asked for help, were content to sit quietly with their hands in the air for extended periods of time while Mr. Martin helped those students who demanded his attention by calling out to him.

How Mr. Martin interacted with these four students does not reflect how he interacted with each student of their respective race and gender. Nonetheless, the race and gender of these students appeared to be related to the interactions they had with Mr. Martin. Teacher intentionality is an important issue in understanding Mr. Martin's interactions with these four students because what we observed was the result of both intended and unintended actions on his part. Furthermore, the students were not passive recipients in the interaction process; their role in molding the form and content of teacher-student interactions must be recognized. We found that knowledge of Mr. Martin's intentions affected how we interpreted what we observed in the classroom. Knowledge of Mr. Martin's intentions makes some of his inappropriate actions understandable, if not acceptable.

Mr. Martin clearly intended to interact with Tim in the way we have described. His interactions with Henry were also intended, but his plan for interacting with Henry was not as clear as his plan for Tim. In the case of both Katrina and Chris, Mr. Martin did not seem to think as much about how he should interact with them; however, he was more aware of and expressed some concern about how he interacted with Chris, although the concern may have been the result of the questions we asked about Chris.

Interviews with Mr. Martin indicated that he saw much of himself in Tim and that he intended to interact with Tim in the way that we observed. As was true during class, even the mention of Tim's name in the interviews brought a smile to Mr. Martin's face and made him laugh. He did not seem to think about and was not concerned about the consequences for the rest of the students of Tim's role in the classroom. When we explicitly asked if Tim's actions might have a negative effect on what the other students learned, Mr. Martin could not identify any such effect. He clearly saw Tim as the best mathematics student in the class, even in the face of his own evidence that Bob's class average was higher than that of Tim. He even explained Bob's performance as a function of his relationship with Tim, not in the sense that Bob "copied" from Tim, but in the sense that Bob benefited simply by sitting next to Tim and being motivated by him. Mr. Martin chose to view the negative responses of other students toward Tim not as a sign that Tim might be having a negative impact on their learning but as a normal response of

people to those who do well. In fact, he accepted the negative response to Tim because he saw it as a source of motivation for Tim to do even better. Mr. Martin was much more concerned about the effect of classroom events on Tim than about the potential negative effect of Tim's actions on his fellow students. Mr. Martin consistently mentioned his goal of motivating Tim to perform even better and of not having Tim doubt himself.

Mr. Martin was not as concerned about maintaining Henry's confidence in himself as a learner of mathematics as he was concerned that Henry not fall victim to what Mr. Martin termed the "athletic syndrome." Mr. Martin's experience as a black student-athlete in college seemed to make him more sensitive to the academic risks involved in an interest in athletics. He was afraid that Henry's early success as an athlete might make him neglect academics. Mr. Martin was convinced that black athletes were capable of performing well in the classroom but that, too often, they neglected academics because they expected to become professional athletes. He expressed some bitterness about the treatment he and other black athletes received in college and wanted to be sure that the black male students he worked with recognized the importance of academic success for their futures. Mr. Martin clearly stated that some of his interactions with Henry were a result of his concern that Henry not fall victim to the athletic syndrome.

Mr. Martin's interactions with Katrina and Chris were not intended in the same sense that his interactions with Tim and Henry were. For example, he did not purposely focus many of his interactions with Katrina on social topics; furthermore, he said

nothing in the interviews about Katrina's mathematical dependence on him and seemed to be unaware of it. On the other hand, Mr. Martin discussed the number of black students in advanced mathematics classes and, in the case of the four black female students who sat together, said that he wanted them to provide a peer support system for each other. However, his concern about a support system seemed to focus on these four black female students and not on the other four black students in the class, one of whom was female.

Mr. Martin expressed some concern during interviews about his lack of interactions with Chris. He gave no indication that any of his interactions with Chris were intended to achieve a specific goal. He clearly saw Chris as being a very capable mathematics student, saying that she and Tim would be the two students from his class who may have been able to succeed in the highest mathematics ability group (which was one group above the high average group they were in). However, he said nothing about the need to spark a competitive urge in her or to keep her from doubting herself, which were the concerns he expressed about Tim.

The point is that a knowledge of Mr. Martin's intentions is important in understanding the teacher-student interactions we observed. We were concerned about Mr. Martin's interactions with all four of the students we have discussed and surprised that in the case of the two male students he was essentially doing what he planned to do. It is significant, we think, that he had a more explicit plan for working with the two male students. Mr.

Martin clearly stated his faith in all of the students in his class; all of them, he felt, were capable of succeeding in mathematics in his class and in subsequent classes. However, the fact that he had a plan to encourage the mathematics learning of Tim and Henry but no comparable plan for Katrina and Chris reflects differences that did not appear in his general statements about the ability of the students in his class and about the importance of mathematics for their futures.

The fact that Mr. Martin had plans for working with Tim and Henry does not mean that both plans benefited the boys to the same extent. Furthermore, the two boys were not passive recipients of plans completely designed and implemented by Mr. Martin; in fact, both boys played important roles in shaping Mr. Martin's plans. What Mr. Martin did with Tim seemed to us to clearly aid Tim's performance in mathematics. Mr. Martin's interactions with Henry, which were guided by his concern about the athletic syndrome, did not have the same kind of positive effect on Henry. Part of Mr. Martin's response to Henry was due to the fact that Henry did seem to have some difficulty in finishing his work. However, other students also had difficulty finishing their work and did not receive the same treatment Henry did. Therefore, although it is significant that Mr. Martin had a more explicit plan for working with the two male students, the effect of the plans was not the same for Henry as it was for Tim.

Based on our interviews with Mr. Martin, then, we decided that teacher intentionality is a very important factor in understanding classroom interaction. In terms of the four

specific students we have described, simply knowing which of Mr. Martin's were intentional and which were not made us look differently at the situation. The fact that he seemed unaware of Katrina's mathematical dependence on him indicated to us that he did not intend to foster that dependence. We were concerned about Katrina's dependence; we would have been even more concerned had we known that Mr. Martin intended to foster it. Likewise, we were concerned about the lack of attention Chris received from Mr. Martin, and it was helpful for us to find out that Mr. Martin expressed concern about it when we brought it up. Knowing that Mr. Martin had a reason for how he interacted with Henry did not alleviate our concern that Henry was developing a negative attitude toward mathematics, but it did make us more aware of the possible conflicting outcomes teachers face as they attempt to achieve worthwhile goals. Finally, in the case of all four students, but especially in Tim's case, knowing Mr. Martin's intentions highlighted the ethical dimension of teachers' work. What Mr. Martin did for Tim helped Tim while having negative consequences for at least some of the other students in the class.

Differential outcomes of equal treatment. In addition to noticing during our observations that Mr. Martin treated individual students differently, we also noticed that in some areas students received equal treatment. More importantly, we noticed students responded differently to this equal treatment. That is, the equal treatment led to different outcomes for different students.

A major topic that continued to come up in our discussions of classroom observations was the issue of clarity. In short, we believe that Mr. Martin was not as clear as he might have been in a number of areas. The main area was giving students directions about classwork and homework; he was also inconsistent in how he followed up on assignments. For example, based on the questions students asked as they left class each day, we concluded that not only were they often confused about whether homework was assigned but they were also confused about the specific content of assignments. There were also times when Mr. Martin assigned a particular page for the students to complete in class without clarifying exactly which exercises he wanted them to do; the students knew that only some of the exercises were to be completed but were not certain of which exercises had to be done. And there were times when, after Mr. Martin assigned particular exercises from a given page, he later changed the assignment, or at least responded differently to different students' questions about what had to be done. In one specific instance, after Mr. Martin had assigned the even exercises on a page, Bob, who was not sure about the assignment, asked Mr. Martin what had to be done. Mr. Martin answered, "Do them all if you want to."

Although we are using the example of Mr. Martin's clarity to show differential outcomes of equal treatment, the importance of understanding teacher intentionality is also involved here. In the interviews with Mr. Martin, he stated that he intended to be less than specific about assignments because he wanted his students to develop more responsibility and independence. He wanted the students to do the assignments in order to gain

knowledge of mathematics, not simply because they were told to do the work. He felt that comments like his response to Bob would foster such responsibility and independence.

The effects of this equal treatment, however, were not the same for all the students. Most students in the class seemed to be able to deal with Mr. Martin's lack of clarity. They kept asking questions about assignments until they got an answer acceptable to them. In interviews, they told us about coming in after class to ask Mr. Martin again about what the homework assignment was or calling each other in the evening for clarification. However, it was more difficult for some students than others to adjust. For example, Henry and Michael, another black male student who sometimes had trouble completing assignments but whom Mr. Martin did not see as a potential victim of the athletic syndrome, sometimes suffered as a result of Mr. Martin's lack of clarity in giving assignments.

A second major example of equal treatment leading to different outcomes has to do with Mr. Martin's general teaching style. Mr. Martin rarely conducted lessons with the whole class where he would explain the content of that day's work. Instead, he would most often assign pages of work at the beginning of the period and help individual students as needed. Occasionally, if many people needed help, Mr. Martin would interrupt the individual seatwork in progress in order to explain an idea to the whole class. As was true in the case of Mr. Martin's clarity, the intentionality issue is involved here as well. Mr. Martin believed that this style was appropriate for this class of

students and for the content they were covering.

Also as was true in the case of Mr. Martin's clarity, this equal treatment of students led to different outcomes. In our interviews with students, we found a wide variety of responses to this aspect of Mr. Martin's teaching style. For example, Chris was very positive about this style because she liked the fact that she did not have to sit through teacher explanations she felt she did not need; Chris preferred to go ahead and work on her own. Interestingly, in one of our interviews with Mr. Martin, he worried that Chris was one of the students who might need more structure, seemingly referring to both the clarity and teaching style examples. Despite the fact that Chris appreciated Mr. Martin's teaching style, we believe his concern about her was justified. Over the course of our observations, Chris received very little teacher instruction in mathematics because she was so reluctant to initiate interactions with Mr. Martin. And even though Mr. Martin's teaching style allowed Chris to work on her own, his organization of the class and her reluctance to ask him for guidance led to numerous occasions where she sat quietly at her desk reading a library book when she could have been doing mathematics. Based on her grades and performance on tests, Chris was a very successful mathematics student. However, the amount of new mathematics she learned was certainly limited by her lack of interaction with the teacher. The challenge that Mr. Martin openly intended to provide Tim was not provided for Chris.

In student interviews, Katrina and Thelma, another member of the group of four black female students, expressed some of the strongest disapproval of Mr. Martin's teaching style. Both of

them referred to their mathematics teacher from the previous year as an example of the kind of teaching style they preferred. According to Katrina and Thelma, this teacher began each class with review of previous work and explanations of new work. We observed, however, that, unlike Chris, the group of four black females did receive a significant amount of teacher instruction in mathematics primarily because they demanded help from Mr. Martin.

The situation in Mr. Martin's classroom was extremely complex. Katrina's constant seeking of help from Mr. Martin perpetuated her mathematical dependence on him while giving her more instructional time with him. Chris demonstrated a great deal of independence while receiving very little instructional time. Tim's independence, combined with his constant demand to be the center of attention in the classroom, led to very different consequences than Chris's more passive independence. The point is that equal treatment, defined as the same teaching style, led to very different outcomes.

Conclusion

Two tentative conclusions that arise from our case study of a seventh-grade mathematics classroom are, then, that teacher intentionality must be considered in order to understand teacher-student interactions and that differential student outcomes can result from equal teacher treatment of students. Although we need to look much more closely at our data in order to clearly substantiate these two tentative conclusions, we believe they represent important contributions to understanding classroom life

and its effects on students.

References

Anick, C. M., Carpenter, T. P., & Smith, C. (1981). Minorities and mathematics: Results from the National Assessment of Educational Progress. Mathematics Teacher, 74, 560-566.

Armstrong, J. M. (1985). A national assessment of participation and achievement of women in mathematics. In S. F. Chipman, L. R. Brush, & D. M. Wilson (Eds.), Women and mathematics: Balancing the equation (pp. 59-94). Hillsdale, NJ: Lawrence Erlbaum.

Brophy, J. E., & Good, T. L. (1974). Teacher-student relationships: Causes and consequences. New York: Holt, Rinehart, and Winston.

Burton, N. W., & Jones, L. V. (1982). Recent trends in achievement levels of black and white youth. Educational Researcher, 11(4), 10-14.

Chipman, S. F., Brush, L. R., & Wilson, D. M. (Eds.). (1985). Women and mathematics: Balancing the equation. Hillsdale, NJ: Lawrence Erlbaum.

Cooper, H., & Good, T. L. (1983). Pygmalion grows up: Studies in the expectation communication process. New York: Longman.

Eccles (Parsons), J. (1984). Sex differences in mathematics participation. In M. W. Steinkamp & M. Maehr (Eds.), Advances in motivation and achievement: Vol. 2. Women in science (pp. 93-137). Greenwich, CT: JAI.

Fennema, E. (1984). Girls, women, and mathematics. In E. Fennema & M. J. Ayer (Eds.), Women and education: Equity or equality? (pp. 137-164). Berkeley, CA: McCutchan.

Fennema, E., & Peterson, P. L. (October, 1983). Autonomous learning behavior: A possible explanation of gender-related differences in mathematics. Paper presented at a conference on gender-related differences at the Wisconsin Center for Education Research, Madison, WI.

Fennema, E., & Peterson, P. L. (1984). Classroom processes, sex differences, and autonomous learning behaviors in mathematics (Contract No. SED 8109077). Washington, DC: National Science Foundation.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitudes Scales. JSAS Catalog of Selected Documents in Psychology, 6, 31. (Ms. No. 1225)

Fennema, E., & Sherman, J. A. (1977). Sex-related differences in mathematics achievement, spatial visualization, and affective factors. American Educational Research Journal, 14, 51-71.

Fennema, E., & Sherman, J. (1978). Sex-related differences in mathematics achievement and related factors: A further study. Journal for Research in Mathematics Education, 9, 189-203.

Good, T. L., & Grouws, D. (1979). The Missouri Mathematics Effectiveness Project: An experimental study in fourth-grade classrooms. Journal of Educational Psychology, 71, 355-362.

Grieb, A., & Easley, J. (1984). A primary school impediment to mathematical equity: Case studies in rule-dependent socialization. In M. W. Steinkamp & M. Maehr (Eds.), Advances in motivation and achievement: Vol. 1 (pp. 317-362). Boston: JAI.

Matthews, W. (1984). Influences on the learning and participation of minorities in mathematics. Journal for Research in Mathematics Education, 15, 84-95.

Matthews, W., Carpenter, T. P., Lindquist, M. M., Silver, E. A. (1984). The Third National Assessment: Minorities and mathematics. Journal for Research in Mathematics Education. 15, 165-171.

Meece, J. L., Parsons, J. E., Kaczala, C. M., Goff, S. B., & Futterman, R. (1982). Sex differences in math achievement: Toward a model of academic choice. Psychological Bulletin, 91, 324-348.

Perl, T. H. (1979). Discriminating factors and sex differences in electing mathematics. Unpublished doctoral dissertation, Stanford University.

Reyes, L. H. (1984). Affective variables and mathematics education. Elementary School Journal, 84, 558-581.

Reyes, L. H., & Fennema, E. (1981). Classroom processes: Observer manual. Madison, WI: Wisconsin Center for Education Research.

Reyes, L. H., & Stanic, G. M. A. (in press). A review of the literature on blacks and mathematics. Journal for Research in Mathematics Education.

Sherman, J., & Fennema, E. (1977). The study of mathematics by high school girls and boys: Related variables. American Educational Research Journal, 14, 159-168.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. Psychological Bulletin, 91, 461-481.

Wolleat, P., Pedro, J. D., Becker, A. D., & Fennema, E. (1980). Sex differences in high school students' causal attributions of performance in mathematics. Journal for Research in Mathematics Education, 11, 356-366.

Yando, R., Seitz, V., & Zigler, E. (1979). Intellectual and personality characteristics of children: Social-class and ethnic-group differences. Hillsdale, NJ: Lawrence Erlbaum.